

20)(Rewritten) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 15 wherein said oxygen spillover catalyst is [selected from the group consisting of] a lanthanum series [oxides and transition metal oxides] oxide.

Remarks

Claims 1-23 are currently pending in the application.

Claims 1 and 12 stand objected to under 35 USC 112, second paragraph, as being indefinite for their inclusion of a stabilizing step in a process that permits/results in the elimination of such a step. Claim 1 has been amended and claim 12 canceled in favor of new claim 24 to correct this oversight. It is respectfully submitted that as now presented neither claim 1 or newly introduced claim 24 include the use of a stabilization step.

Claims 6-9 and 17-20 stand rejected under 35 USC 112, second paragraph for their redundant language that recites both transition metal oxides and lanthanum series oxides. Claims 6-9 and 17-20 have been rewritten to eliminate this redundancy.

Claims 1-3, 6-10, 12-14 and 17-21 stand rejected under 35 USC 102(b) as anticipated by Tachibana, U.S. Patent No. 4,970,189. It is the Examiner's position that, "Tachibana discloses a process of mixing fine particles of a metal oxide,

preferably a transition metal and optionally iron, in an organic substance that may be heated to produce a carbonaceous body, such as petroleum or coal tar pitch".

While the Examiner may be correct in this analysis, it is pointed out that the transition metal elements, the 38 elements in groups 3-12 of the periodic table, do not include the lanthanum series elements. As currently amended, the claims of the instant application clearly exclude the use of transition series metal oxides and include only the lanthanum series metal oxides.

In order to present a further elucidation of the invention of the present application, the following additional comments are offered. Oxygen transport at the atomic level is refers to the phenomenon commonly called (and well-known as) oxygen spillover (a catalytic process). The mechanism of oxygen spillover involves two steps: (1) a reducing molecule (in the instant case, the carbon precursor) extracts oxygen of the solid (O_s) out of the lattices, and (2) the O_s vacancy is then replenished by dioxygen (O_2) from the gas phase.

The lattice oxygen in M_xO_y (where M=elemental metal, O=atomic oxygen) can react with C/C composite (or other) precursors. This is different than the conventional approach in which the stabilization process is performed with molecular oxygen from air. M_xO_y serves as a catalyst to adsorb and dissociate molecular (combined) oxygen to atomic oxygen. The material thus serves as a storage medium for atomic oxygen. Stabilization without the presence of the catalyst will take over 40 hours. In the presence of a catalyst, the process can be

shortened to less than 4 hours or totally by-passed if a sufficient amount of catalyst is used.

Reactivity of atomic oxygen:

Atomic oxygen is more active than molecular oxygen.

Diffusion limitation:

Stored oxygen (in atomic form) alleviates any diffusion limitation.

As stated above, lanthanum series elements are not transition metals.

Lanthanum series oxides have, in fact, been found to be far superior oxygen storage and oxygen spillover catalysts than transition metal oxides.

In view of the foregoing, it is respectfully submitted that rejection of the claims of the instant application as currently presented is improper and that such rejection should be withdrawn.

Claims 4-5 and 15-16 stand similarly rejected under 35 USC 102(b) as anticipated by Tachibana. For the reasons expressed hereinabove, clearly distinguishing the transition metal oxide teachings of Tachibana from the lanthanum series oxide teachings and claims of the present invention, it is similarly respectfully submitted that rejection of these claims on the basis of Tachibana is similarly improper and should be withdrawn.

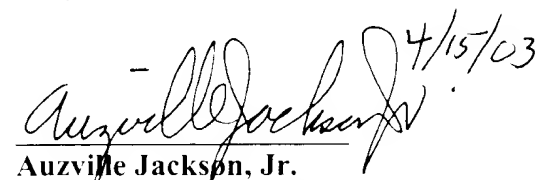
Claims 1, 3, 11 and 22 stand rejected under 35 USC 102(b) as anticipated by Sawaki et al, U.S. Patent No. 4,840,762. In this instance, it is the Examiner's position that, "Sawaki et al disclose a process for the production of carbon fibers whereby a fine powder of metal oxide including those of zinc and titanium are added to a pitch fiber bundle prior to stabilization and carbonization. It is again respectfully pointed out that while zinc and titanium are transition metals, they are not lanthanum series elements and hence their oxides will not and cannot provide oxygen at the atomic level as described and claimed in the instant application. Thus, rejection of the claims of the instant application on the basis of this reference is similarly improper and that such rejection should be withdrawn.

Claim 23 stands rejected under 35 U.S.C. 102(b) as anticipated by Hamling, U.S. Patent No. 3,385,915, specific reference is made to Example 6. In this example, chlorides of aluminum, copper, iron and nickel are utilized. None of these materials are either "metal oxides" or metal oxides of lanthanum series elements as currently claimed in the instant application. Thus, it is again respectfully submitted that rejection of the claims of the instant application as anticipated by Hamling is improper and that such rejection should be withdrawn.

In view of the foregoing amendments to the claims and the remarks presented hereinabove, it is respectfully submitted that the claims of the instant application as currently presented stand in condition for allowance and the same is respectfully requested at an early date.

Clean and Marked-up copies of the amended pages of claims are enclosed
herewith.

Respectfully submitted,


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What is claimed is:

- 1) In a process for the fabrication of carbon foams, carbon fibers, carbon ceramic composites and C/C composites from a petroleum or coal pitch, polyacrylonitrile or rayon and including the steps of forming a carbon precursor, and stabilizing and carbonizing said carbon precursor, the improvement comprising eliminating the stabilization step through the use of a process comprising:

providing to said carbon precursor, at the atomic level an oxygen spillover catalyst that permits shortening or elimination of said stabilization step.

- 2) The method of claim 1 wherein said oxygen spillover catalyst is provided to said carbon precursor by blending of said oxygen spillover catalyst with said petroleum or coal pitch, polyacrylonitrile or rayon starting material prior to formation of said carbon precursor.

- 3) The method of claim 1 wherein said oxygen spillover catalyst is provided to said carbon precursor by exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization.

- 4) The method of claim 2 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 1 to about 50 percent by weight

of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

- 5 5) The method of claim 4 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 5 to about 30 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.
- 10 6) The method of claim 1 wherein said oxygen spillover catalyst is [selected from the group consisting of oxides of] a lanthanum series [oxides and transitions metal oxides] oxide.
- 15 7) The method of claim 2 wherein said oxygen spillover catalyst is a lanthanum series [or transition metal] oxide.
- 8) The method of claim 3 wherein said oxygen spillover catalyst is a lanthanum series [or transition metal oxide].
- 20 9) The method of claim 4 wherein said oxygen spillover catalyst is [selected from the group consisting of] a lanthanum series [oxides and transition metal oxides] oxides.

10) The method of claim 9 wherein said oxygen spillover catalyst is selected from the group consisting of cerium oxide, praseodymium oxide, terbium oxide and iron oxide.

5 11) The method of claim 3 wherein said exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization is accomplished by spraying said carbon precursor with said oxygen spillover catalyst prior to stabilization or carbonization.

10 [12) A carbon foam, carbon fiber, carbon ceramic composite or C/C composite fabricated from a petroleum or coal pitch, polyacrylonitrile or rayon by a process comprising:

A) forming a carbon precursor; and

B) stabilizing and carbonizing said carbon precursor and further

15 including:]

providing to said carbon precursor, at the atomic level, an oxygen

spillover catalyst that permits shortening or elimination of said stabilization step].

20 13) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is provided to said carbon precursor by blending of said oxygen spillover catalyst

with said petroleum or coal pitch, polyacrylonitrile or rayon starting material prior to formation of said carbon precursor.

14) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is provided to said carbon precursor by exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization.

15) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 13 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 1 to about 50 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

16) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 15 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 5 to about 30 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

17) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is [selected from the group consisting of oxides of] a lanthanum series [oxides and transitions metal oxides] oxide.

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18) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 13 wherein said oxygen spillover catalyst is a lanthanum series [or transition metal] oxide.

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19) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 14 wherein said oxygen spillover catalyst is a lanthanum series [or transition metal] oxide.

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20) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 15 wherein said oxygen spillover catalyst is [selected from the group consisting of] a lanthanum series [oxides and transition metal oxides] oxides.

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21) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 20 wherein said oxygen spillover catalyst is selected from the group consisting of cerium oxide, praseodymium oxide, terbium oxide and iron oxide.

22) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 14 wherein said exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization is accomplished by spraying said carbon precursor with said oxygen spillover catalyst prior to stabilization or carbonization.

23) A carbon material selected from the group consisting of carbon foams, carbon fibers, carbon metal composites and carbon/carbon composites containing lanthanum series or transition metal oxides.

24) A carbon foam, carbon fiber, carbon ceramic composite or C/C composite fabricated from a petroleum or coal pitch, polyacrylonitrile or rayon by a process comprising:

A) forming a carbon precursor;

B) providing to said carbon precursor, at the atomic level, an oxygen spillover catalyst; and

C) forming said carbon foam, carbon fiber, carbon ceramic composite or C/C composite

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What is claimed is:

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- 1) In a process for the fabrication of carbon foams, carbon fibers, carbon ceramic composites and C/C composites from a petroleum or coal pitch, polyacrylonitrile or rayon and including the steps of forming a carbon precursor, and stabilizing and carbonizing said carbon precursor, the improvement comprising eliminating the stabilization step through the use of a process comprising:

providing to said carbon precursor, at the atomic level an oxygen spillover catalyst that permits shortening or elimination of said

10 stabilization step.

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- 2) The method of claim 1 wherein said oxygen spillover catalyst is provided to said carbon precursor by blending of said oxygen spillover catalyst with said petroleum or coal pitch, polyacrylonitrile or rayon starting material prior to formation of said carbon precursor.

- 20
- 3) The method of claim 1 wherein said oxygen spillover catalyst is provided to said carbon precursor by exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization.

- 4) The method of claim 2 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 1 to about 50 percent by weight

of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

5 5) The method of claim 4 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 5 to about 30 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

10 6) The method of claim 1 wherein said oxygen spillover catalyst is a lanthanum series oxide.

 7) The method of claim 2 wherein said oxygen spillover catalyst is a lanthanum series oxide.

15 8) The method of claim 3 wherein said oxygen spillover catalyst is a lanthanum series oxide.

 9) The method of claim 4 wherein said oxygen spillover catalyst is a
20 lanthanum series oxide.

10) The method of claim 9 wherein said oxygen spillover catalyst is selected from the group consisting of cerium oxide, praseodymium oxide, terbium oxide and iron oxide.

5 11) The method of claim 3 wherein said exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization is accomplished by spraying said carbon precursor with said oxygen spillover catalyst prior to stabilization or carbonization.

10 13) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is provided to said carbon precursor by blending of said oxygen spillover catalyst with said petroleum or coal pitch, polyacrylonitrile or rayon starting material prior to formation of said carbon precursor.

15 14) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is provided to said carbon precursor by exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization.

20 15) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 13 wherein said oxygen spillover catalyst is blended

with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 1 to about 50 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

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16) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 15 wherein said oxygen spillover catalyst is blended with said petroleum or coal pitch, polyacrylonitrile or rayon starting material at a concentration of from about 5 to about 30 percent by weight of said petroleum or coal pitch, polyacrylonitrile or rayon starting material.

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17) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 12 wherein said oxygen spillover catalyst is a lanthanum series oxide.

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18) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 13 wherein said oxygen spillover catalyst is a lanthanum series oxide.

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19) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 14 wherein said oxygen spillover catalyst is a lanthanum series oxide.

20) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 15 wherein said oxygen spillover catalyst is a lanthanum series oxide.

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21) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 20 wherein said oxygen spillover catalyst is selected from the group consisting of cerium oxide, praseodymium oxide, terbium oxide and iron oxide.

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22) The carbon foam, carbon fiber, carbon ceramic composite or C/C composite of claim 14 wherein said exposure of said carbon precursor to said oxygen spillover catalyst during stabilization or carbonization is accomplished by spraying said carbon precursor with said oxygen spillover catalyst prior to stabilization or carbonization.

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23) A carbon material selected from the group consisting of carbon foams, carbon fibers, carbon metal composites and carbon/carbon composites containing lanthanum series or transition metal oxides.

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24) A carbon foam, carbon fiber, carbon ceramic composite or C/C composite fabricated from a petroleum or coal pitch, polyacrylonitrile or rayon by a process comprising:

A) forming a carbon precursor;

B) providing to said carbon precursor, at the atomic level, an
oxygen spillover catalyst; and

C) forming said carbon foam, carbon fiber, carbon ceramic
composite or C/C composite

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